Lewis Sumner
Vice President
Hatch Project Support

Southern Nuclear Operating Company, Inc.
40 Inverness Parkway
Post Office Box 1295
Birmingham, Alabama 35201

Tel 205 992 7279
Fax 205 992 0341

SOUTHERN COMPANY
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October 4, 2002

Docket Nos. 50-321
50-366

HL-6304

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Edwin I. Hatch Nuclear Plant
Emergency Implementing Procedure Revision

Ladies and Gentlemen:

In accordance with 10 CFR 50, Appendix E, Section V, Southern Nuclear Operating Company hereby submits the following revision to the Plant Hatch Emergency Implementing Procedure (EIP):

EIP No.	Version	Effective Date
73EP-EIP-023-0S	0.3	9/18/02

This revision incorporates changes to enhance information flow to offsite agencies and other editorial changes.

By copy of this letter, Mr. L. A. Reyes, NRC Region II Administrator, will receive two copies of the revised procedure.

Should you have any questions in this regard, please contact this office.

Respectfully submitted,

Lewis Sumner

H. L. Sumner, Jr.

CKB/eb

Enclosure: 73EP-EIP-023-0S, Core Damage Assessment

A045

cc: Southern Nuclear Operating Company (w/o)
Mr. P. H. Wells, Nuclear Plant General Manager
SNC Document Management (R-Type A02.001)

U.S. Nuclear Regulatory Commission, Washington, D.C.(w/o)
Mr. Joseph Colaccino, Project Manager - Hatch

U.S. Nuclear Regulatory Commission, Region II
Mr. L. A. Reyes, Regional Administrator (with 2 copies)
Mr. J. T. Munday, Senior Resident Inspector – Hatch (w/o)

SOUTHERN NUCLEAR PLANT E.I. HATCH	DOCUMENT TYPE: EMERGENCY PREPAREDNESS PROCEDURE		PAGE 1 OF 18
DOCUMENT TITLE: CORE DAMAGE ASSESSMENT		DOCUMENT NUMBER: 73EP-EIP-023-0S	REVISION/VERSION NO: 0.3
EXPIRATION DATE: N/A	APPROVALS: DEPARTMENT MANAGER CLC DATE 9-19-90 NPGM/POAGM/PSAGM HLS DATE 9-19-90		EFFECTIVE DATE: 09/18/2002

1.0 OBJECTIVE

The objective of this procedure is to provide the instruction necessary during emergency conditions to evaluate the extent of core damage.

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2.0 APPLICABILITY

This procedure is applicable to the evaluation of core damage under accident conditions for both Unit 1 and Unit 2. Procedure frequency will be as necessary. Individual subsections, or methods for determining core damage, may be performed out of sequence IF necessary to expedite the determination of core damage.

3.0 REFERENCES

3.1 10AC-MGR-006-0S, Hatch Emergency Plan

3.2 NEDO-2215, Procedure for the Determination of the Extent of Core Damage Under Accident Conditions, by C.C. Lin

3.3 NEDE-30050A, Engineering Training, Degraded Core

3.4 FULL SIZE FORM

- TRN-0114, Core Damage Assessment Log

4.0 REQUIREMENTS

4.1 PERSONNEL REQUIREMENTS

Personnel performing this procedure must be trained in performing the calculations required by this procedure and familiar with procedure content.

4.2 MATERIAL AND EQUIPMENT

Calculator or computer for performing calculations

4.3 SPECIAL REQUIREMENTS

N/A - Not applicable to this procedure

5.0 PRECAUTIONS/LIMITATIONS

5.1 PRECAUTIONS

N/A - Not applicable to this procedure

5.2 LIMITATIONS

The calculation of core damage fraction is only as accurate as the measurements used in this procedure's calculations. Accurate measurements of Cs-137 and Kr-85 activities are not very likely until the reactor has been shut down for longer than a few weeks and most of the shorter-lived isotopes have decayed.

6.0 PREREQUISITES

An abnormal plant condition, drill or exercise must exist prior to performing this procedure.

REFERENCE

7.0 PROCEDURE

7.1 CORE DAMAGE ESTIMATE BASED ON FISSION PRODUCT CONCENTRATION

7.1.1 RCS/CAS Sampling

Request the OSC to dispatch a PASS RET team to obtain a reactor coolant and/or containment atmosphere sample and perform a gamma isotopic analysis of the sample(s).

NOTE:	PASS reactor coolant data will be provided in μCi/ml. This unit of measure is equivalent to μCi/g and does not need to be converted.

7.1.1.1 Obtain the following applicable information from the PASS RET team when the gamma isotopic analysis of the sample(s) are complete:

- Reactor coolant I-131 and Cs-137 concentration (μCi/g)
- Containment atmosphere Xe-133 and Kr-85 concentration (uCi/cc)
- Containment atmosphere pressure (psig) and temperature (°F)
- Containment atmosphere manual grab sample pressure (psig) and temperature (°F) [available only if manual grab sample is obtained]
- Method of sampling (automated system or manual grab sample)

7.1.1.2 Request the PASS RET team to provide a copy of the sample's gamma isotopic analysis results to the TSC Reactor Engineer.

7.1.2 Pressure/Temperature and Decay Correction

7.1.2.1 Record the following applicable information on TRN-0114, Core Damage Assessment Log:

- I-131 and Cs-137 concentrations as C_w
- Xe-133 and Kr-85 concentration(s) as C_g
- Containment atmosphere pressure and temperature
- Containment atmosphere manual grab sample pressure and temperature [available only if manual grab sample is obtained]

7.1.2.2 Decay correct the measured concentration(s) of I-131 and Cs-137 in Reactor Coolant from the time of reactor shutdown by using the following formula. Record the decay corrected water sample concentrations (C_{wo}) for I-131 and Cs-137 on TRN-0114, Core Damage Assessment Log.

$$C_{wo} = C_w e^{\lambda t}$$

Where:

C_{wo} = activity concentration in water sample decay corrected to the time of shutdown (μCi/g)

C_w = measured activity concentration in water sample (μCi/g)

λ = decay constant of isotope: I-131 = 0.086/days; Cs-137 = 6.31 E-5/days

t = decay time between reactor shutdown and analysis of activity concentration (days)

7.1.2.3 IF the I-131 concentration is determined to be greater than 100 μCi/g, report this information to the TSC Manager and the Emergency Director to evaluate for appropriate emergency classification.

7.1.2.4 Decay correct the measured concentrations of Xe-133 and Kr-85 in Containment Atmosphere from the time of reactor shutdown by using the applicable formula below. Record the corrected gas sample concentrations (C_{go}) for Xe-133 and Kr-85 on TRN-0114, Core Damage Assessment Log.

IF the method of sampling is:	THEN:
Automated	Use the following formula: $$C_{go} = C_g e^{\lambda t}$$ Where: C_{go} = activity concentration in gas sample decay and pressure/temperature corrected to time of shutdown(uCi/cc) C_g = measured activity concentration in gas sample (µCi/cc) λ = decay constant of isotope: Xe-133 = 0.131/days, Kr-85 = 1.77 E-4/days t = decay time between reactor shutdown and analysis of activity concentration
Manual Grab	Use the following formula: $$C_{go} = C_g e^{\lambda t}\left(\frac{P_2 T_1}{P_1 T_2}\right)$$ Where: C_{go} = activity concentration in gas sample decay and pressure/temperature corrected to time of shutdown(uCi/cc) C_g = measured activity concentration in gas sample (µCi/cc) λ = decay constant of isotope: Xe-133 = 0.131/days, Kr-85 = 1.77 E-4/days t = decay time between reactor shutdown and analysis of activity concentration P_2 = Containment pressure (psig) T_2 = Containment temperature (°F) P_1 = Manual Grab sample pressure (psig) T_1 = Manual Grab sample temperature (°F)

7.1.3 Analysis of Fission Product Concentration

Compare the sample activities to the upper limit values on Table 1, Fission Product Concentrations In Reactor Water and Drywell Gas Space During Reactor Shutdown Under Normal Conditions.

7.1.3.1 IF the corrected concentration of a fission product in reactor water or containment atmosphere is measured to be higher than the upper limit values shown in Table 1, perform subsection 7.1.4 through 7.1.5. The extent of fuel or cladding damage can then be determined directly from Attachment 1 based on isotopes I-131, Cs-137, Xe-133, and Kr-85.

7.1.3.2 IF the corrected concentrations fall into the range where release of the fission product from the fuel gap or the molten fuel cannot be definitively determined, perform subsection 7.1.4 through subsection 7.1.7. The additional data in subsections 7.1.6 and 7.1.7 may be needed to determine the source of fission product release.

TABLE 1

FISSION PRODUCT CONCENTRATIONS IN REACTOR WATER AND DRYWELL GAS SPACE DURING REACTOR SHUTDOWN UNDER NORMAL CONDITIONS

ISOTOPE	REACTOR WATER (uCi/g)		DRYWELL GAS (uCi/cc)	
	UPPER LIMIT	NOMINAL	UPPER LIMIT	NOMINAL
I-131	29 (Note D)	0.7 (Note D)		
Cs-137 (Note C)	0.3 (Note A)	.03 (Note B)		
Xe-133			1 E-4 (Note A)	1 E-5 (Note B)
Kr-85			4 E-5 (Note A)	4 E-6 (Note B)

Note A: Observed experimentally, in an operating BWR/3 with Mark I containment.
Note B: Assuming 10% of the upper limit values.
Note C: Release of Cs-137 will strongly depend on core inventory which is a function of fuel burnup.
Note D: These values consider iodine spiking, i.e., they are the highest values expected in a "normal" iodine spiking transient.

7.1.4 Fission Product Inventory

Calculate and record on TRN-0114, Core Damage Assessment Log, the inventory correction factor for each isotope by performing the following:

NOTE:	• Calculating reactor operation back from time of shutdown for a period equal to 6 isotope half-lives will normally be accurate enough. • The half- lives of the applicable isotopes are as follows: I-131 = 8.05 days; Cs-137 = 30 years; Xe-133 = 5.27 days; Kr-85 = 10.76 years.

7.1.4.1 Break the reactor power history prior to the event into "N" periods. In each period power variations must normally be limited to $\pm$ 20%. Record the results on TRN-0114, Core Damage Assessment Log.

7.1.4.2 Calculate the Inventory Correction Factor for each isotope "i" using the following formula. Record results on TRN-0114, Core Damage Assessment Log.

$$F_{Ii} = \frac{3651\left[1 - e^{-1095\,\lambda}\right]}{\sum_{j=1}^{n}\left[P_j\left(1 - e^{-\lambda T_j}\right)e^{-\lambda T^{\circ}_j}\right]}$$

Where:

F_{Ii} = inventory correction factor for isotope "i"

P_j = steady reactor power operated in period j (MWth)

T_j = duration of operating period j (day)

T°_j = time (in days) between the end of operating period j and time of the last reactor shutdown (day)

λ= decay constant of isotope: Xe-133 = 0.132/days, Kr-85 = 1.77E-4/days, I-131 = .086/days, Cs-137 = 6.29E-5/days

7.1.5 Equivalent Activity Concentration and Fuel Damage Assessment

NOTE:	• The dilution correction factor for either a Unit 1 or a Unit 2 water sample (F_w) is 0.68. • The dilution correction factor for either a Unit 1 or a Unit 2 gas sample (F_g) is 0.18.

7.1.5.1 Calculate the equivalent activity concentration (C_{zw} and C_{zg}) for each isotope, using the following formulas. Use the results from 7.1.2.2, 7.1.2.4, 7.1.4.2, 7.1.5.1 and 7.1.5.2 and the applicable dilution correction factor from the note above.

$$C_{zw} = C_{wo} \times F_I \times F_w$$
$$C_{zg} = C_{go} \times F_I \times F_g$$

Record results on TRN-0114, Core Damage Assessment Log

7.1.5.2 Compare the calculated equivalent activity concentrations with the appropriate graph in Attachment 1 to determine the amount of produced (i.e., fraction of fuel tubes with failed cladding or fraction of UO_2 melted). Record results on TRN-0114, Core Damage Assessment Log.

7.1.6 Isotope Ratio Comparison

NOTE:	Because certain isotopes will be released preferentially due to a cladding failure versus a fuel melting, the presence of higher or lower relative amounts provide an indication of which type of failure occurred.

7.1.6.1 Determine from the isotopic analysis of the containment atmosphere gas sample and reactor coolant sample the concentrations of Xe-133, Kr-87, Kr-88, and Kr-85m, I-131, I-132, I-133, I-134 and I-135. Record on TRN-0114, Core Damage Assessment Log.

7.1.6.2 Decay correct the above concentrations to the time of shutdown using the following formula. Record the results on TRN-0114, Core Damage Assessment Log:

$$A_o = A\,e^{\lambda t}$$

Where:

A_o= activity concentration decay corrected to time of shutdown

A = measured activity concentration in sample

λ= decay constant of isotope: Xe-133 = 0.131/days, Kr-85m = 3.7/days, Kr-87 = 13.13/days, Kr-88 = 5.94/days, I-131 = 0.086/days, I-132 = 7.263/days, I-133 = 0.8/days, I-134 = 18.972/days and I-135 = 2.535/days

t = decay time between reactor shutdown and analysis of isotope concentration (days)

7.1.6.3 Determine the ratio of the decay corrected noble gas concentrations (Kr-87, Kr-88, and Kr-85m) to the Xe-133 concentration (decay corrected to time of shutdown). Record the resulting ratios on TRN-0114, Core Damage Assessment Log.

7.1.6.4 Determine the ratio of the decay corrected iodine isotope concentrations (I-132, I-133, I-134, and I-135) to the I-131 concentration (decay corrected to time of shutdown). Record the resulting ratios on TRN-0114, Core Damage Assessment Log.

7.1.6.5 Compare the ratio(s) to the expected values given in Table 2, Ratios of Isotopes in Core Inventory and Fuel Gap. Record any conclusions reached as to cladding failure or fuel melt on TRN-0114, Damage Assessment Log.

TABLE 2

RATIOS OF ISOTOPES IN CORE INVENTORY AND FUEL GAP

ISOTOPE	HALF-LIFE	ACTIVITY RATIO IN CORE INVENTORY	ACTIVITY RATIO IN FUEL GAP
Kr-87	76m	0.233	0.0234
Kr-88	2.84h	0.33	0.0495
Kr-85m	4.48h	0.122	0.023
I-134	52.6m	2.3	0.155
I-132	2.28h	1.46	0.127
I-135	6.59h	1.97	0.364
I-133	20.8	2.09	0.685

7.1.7 Low Volatility Isotopes

Another indication of a fuel melt release is the presence of low volatility isotopes. IF the less volatile fission products, [i.e., isotopes of Sr, Ba, and Ru (either soluble or insoluble)] are found to have unusually high concentrations in the water sample, a fuel meltdown to some extent may be assumed. In a mixture of fission products, 2.7h Sr-92 (1.385 MeV) and 40h La-140 (1.597 MeV) will normally be relatively easy to identify and measure through gamma isotopic analysis.

7.1.7.1 Record on TRN-0114, Core Damage Assessment Log the concentrations of any isotope of the following elements measured: Sr, Ba, Ru and La.

7.1.7.2 Record on TRN-0114, Core Damage Assessment Log the conclusions reached, if any, concerning Cladding Failure or Fuel Melt.

7.2 CORE DAMAGE ESTIMATE BASED ON DRYWELL WIDE RANGE MONITORS

7.2.1 Determine the Drywell Wide Range Monitor (DWWRM) reading, (D11-K621 A & B found on panels H11-P689 and H11-P690) (R) in Rem/hr. Record the results on TRN-0114, Core Damage Assessment Log.

7.2.2 Determine elapsed time from plant shutdown to the DWWRM reading (t) in hours. Record the results on TRN-0114, Core Damage Assessment Log.

7.2.3 Use Attachment 2 to determine the reference plant fuel inventory release I_{ref} in %. Record the results on TRN-0114, Core Damage Assessment Log.

7.2.4 Determine the inventory release to the containment (I) using the following formula. Record the results on TRN-0114, Core Damage Assessment Log.

$$I = I_{ref}\,(.6855) \times (V) \times (6/D)$$

Where:

V = normalizing of total containment free volume: Unit 1 = 1.08, Unit 2 = 1.07

D = distance of detector from reactor biological shield wall, ft.
1D11-K621 A = 2.5 ft, 1D11-K621 B = 3.5 ft
2D11-K621 A = 2.5 ft, 2D11-K621 B = 3.5 ft

7.2.5 IF the DWWRM are inoperable, Post LOCA Monitor readings must be used to calculate an estimate of core damage. The following equation must be used to determine the equivalent DWWRM reading:

Equivalent DWWRM Reading = (Post LOCA monitor reading) (10^X)

Where X = the Log (multiplier) from Attachment 3.

7.2.6 Compare the hours after shutdown (on x-axis) with the curve plotted on Attachment 3 to determine the log (multiplier) (on y-axis). Once the Equivalent DWWRM reading is determined, complete steps 7.2.3 and 7.2.4.

7.3 CORE DAMAGE ESTIMATE BASED ON CONTAINMENT HYDROGEN

A consequence of inadequate cooling (loss-of-coolant accident) can be the production of hydrogen; the primary source is from the zirconium water reaction. The extent of fuel clad damage can be estimated by determination of containment hydrogen concentration.

7.3.1 Obtain the containment hydrogen monitor reading in % hydrogen (%H) and record on TRN-0114, Core Damage Assessment Log.

7.3.2 Apply the containment % H to Attachment 4, Containment % Hydrogen Versus % Zr-Steam Reaction, to determine the percent Zr-Steam reaction for the reference plant (% Zr-$Steam_{Ref}$). Record on TRN-0114, Core Damage Assessment Log.

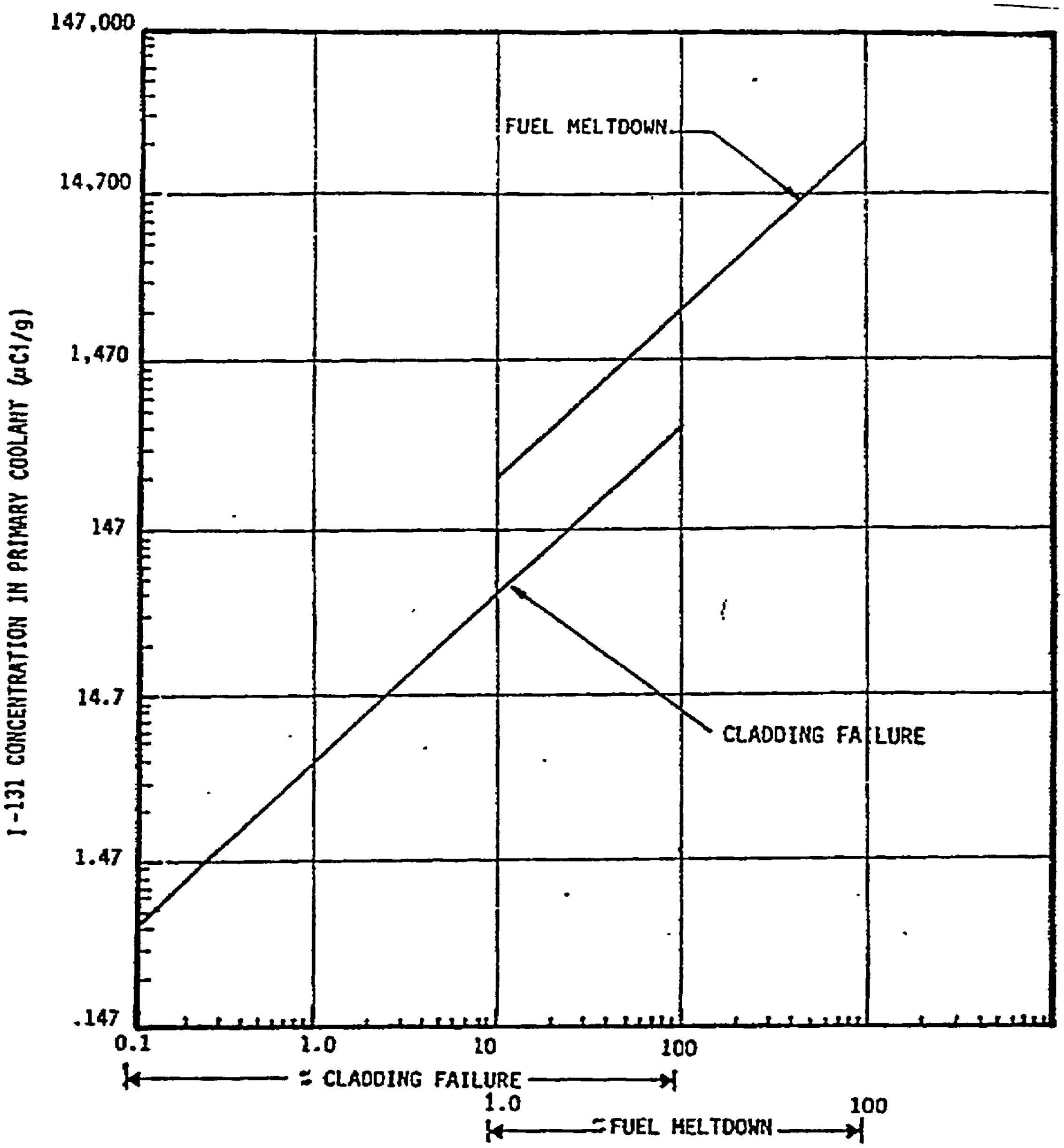
7.3.3 Determine the % Zr-Steam reaction (extent of fuel clad damage) by performing the following calculation and record the % Zr-Steam reaction on TRN-0114, Core Damage Assessment Log.

$$\% \text{ Fuel Clad Damage} = (\% \text{ Zr-Steam}_{Ref}) \times (.925)$$

7.4 RECORDS

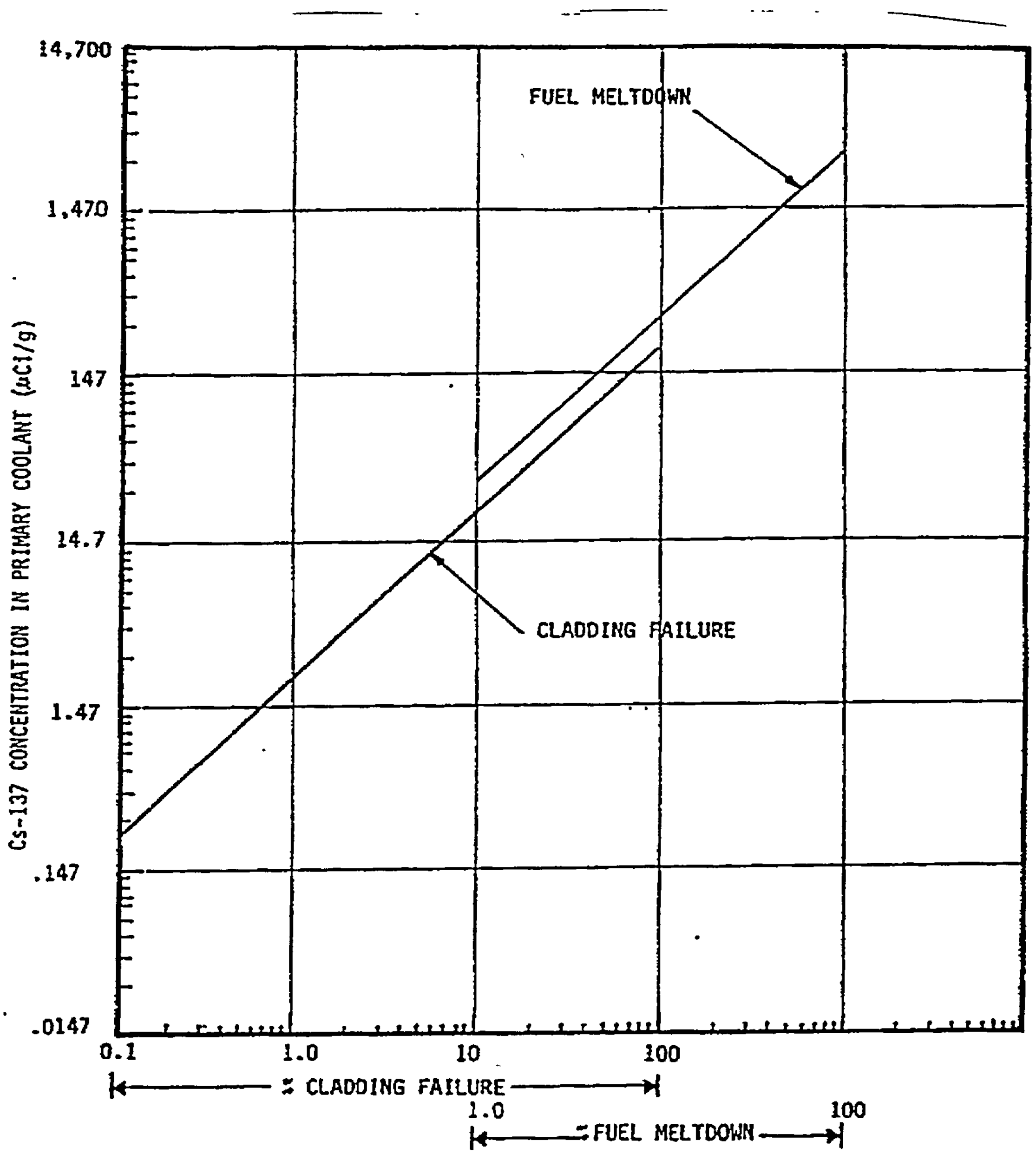
Submit completed TRN-0114, Core Damage Assessment Log sheets to the Technical Support Center (TSC) Manager for review and evaluation. Records generated during actual emergencies will be maintained in accordance with 20AC-ADM-002-0S, Quality Assurance Records Administration.

I-131



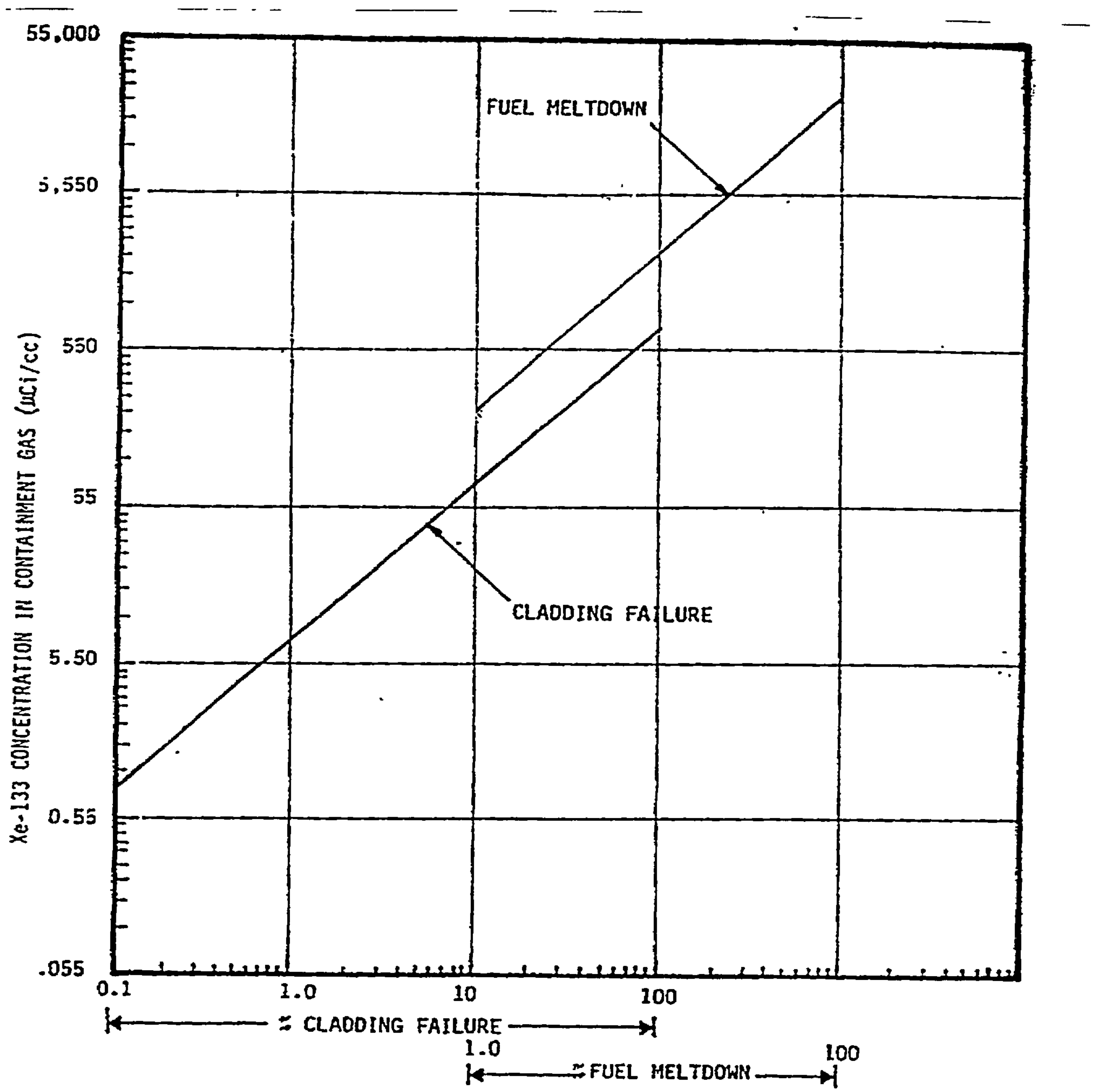
Relationship Between I-131 Concentration in the Primary Coolant (Reactor Water + Pool Water) and Extent of Core Damage.

Cs-137



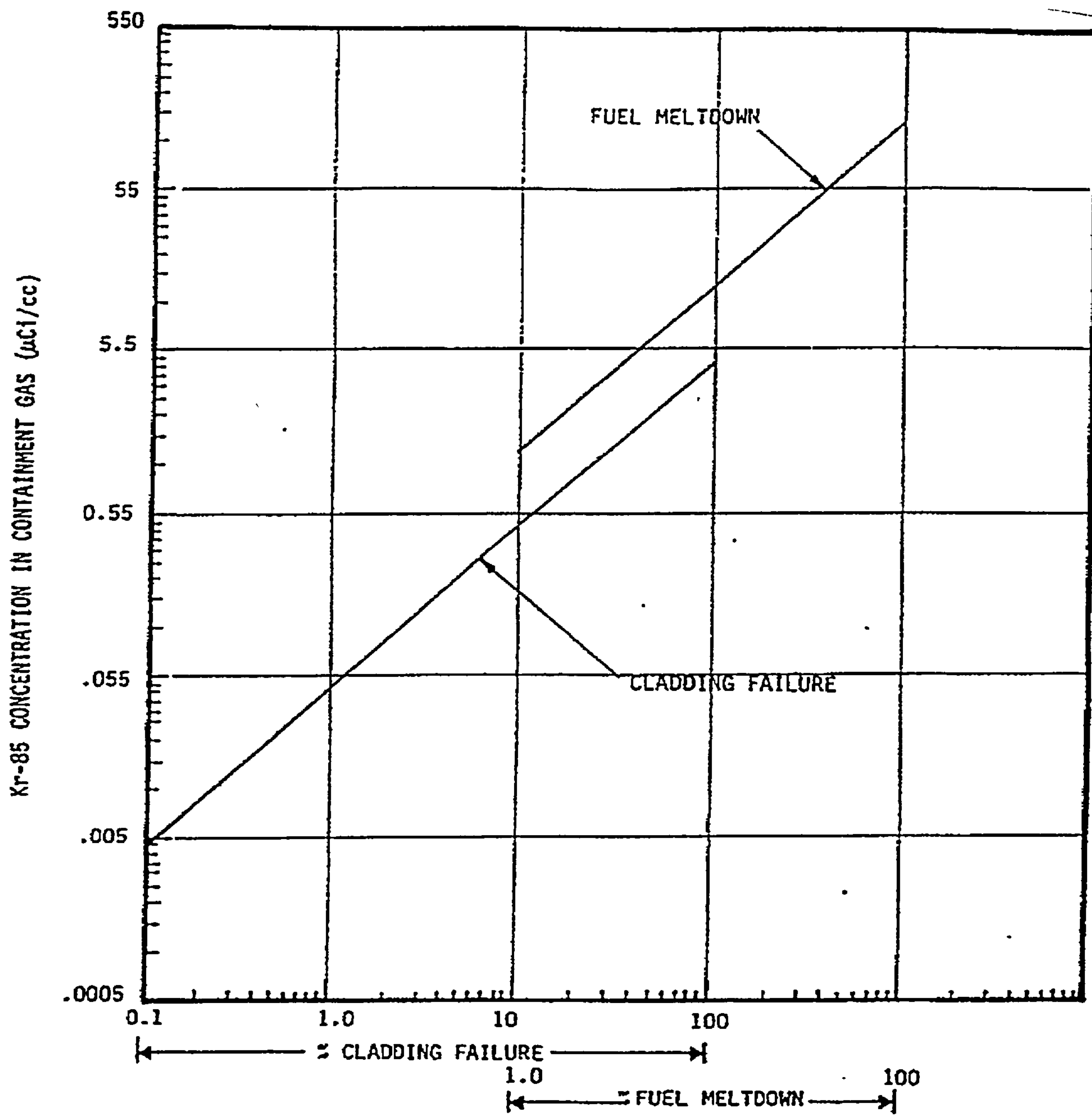
Relationship Between Cs-137 Concentration in the Primary Coolant (Reactor Water + Pool Water) and Extent of Core Damage

Xe-133

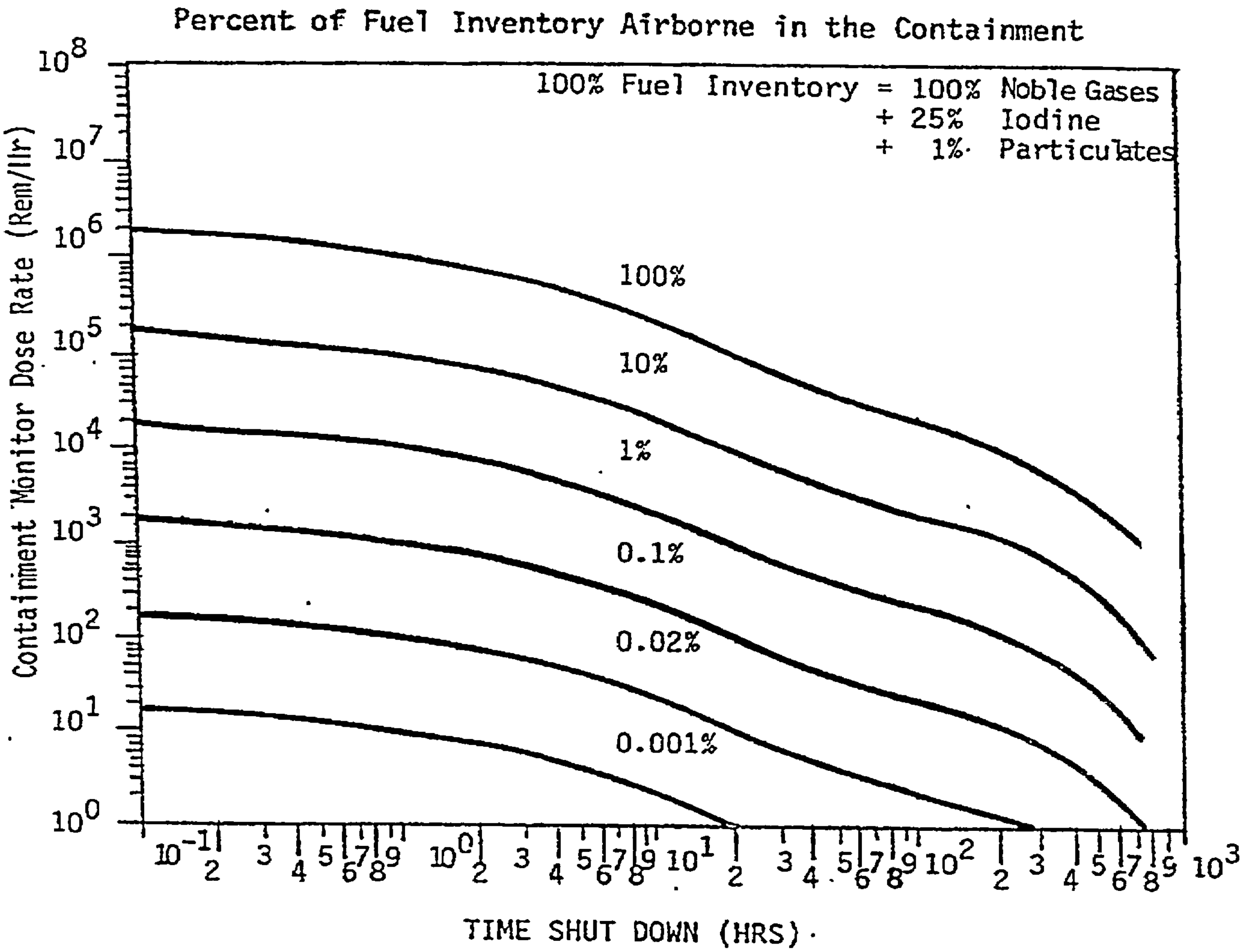


Relationship Between Xe-133 Concentration in the Containment Gas (Drywell + Torus Gas) and Extent of Core Damage

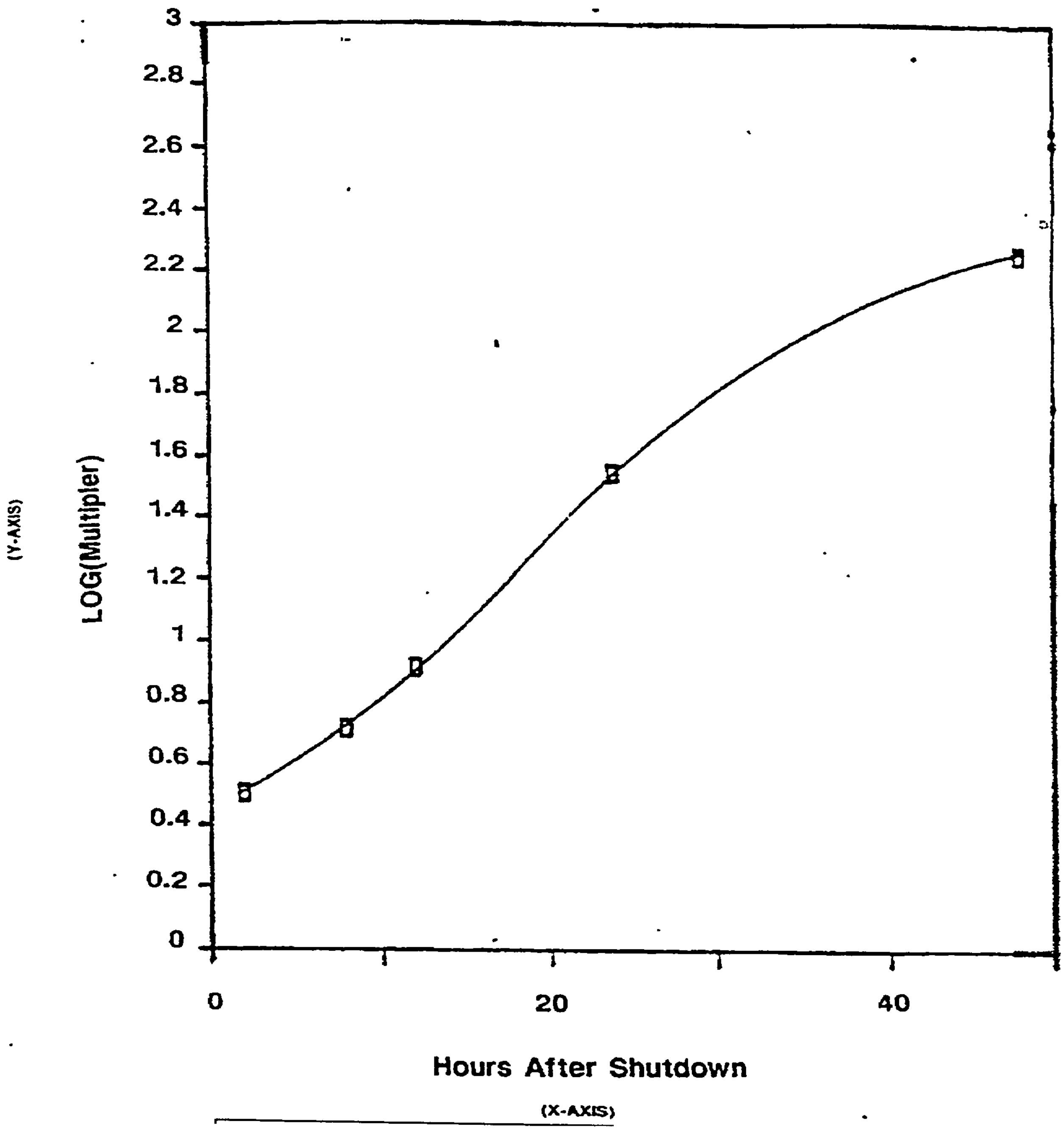
Kr-85



Relationship Between Kr-85 Concentration in the Containment Gas (Drywell + Torus Gas) and Extent of Core Damage



Percent of Fuel Inventory Airborne in Containment



Post LOCA Monitor Log Multiplier

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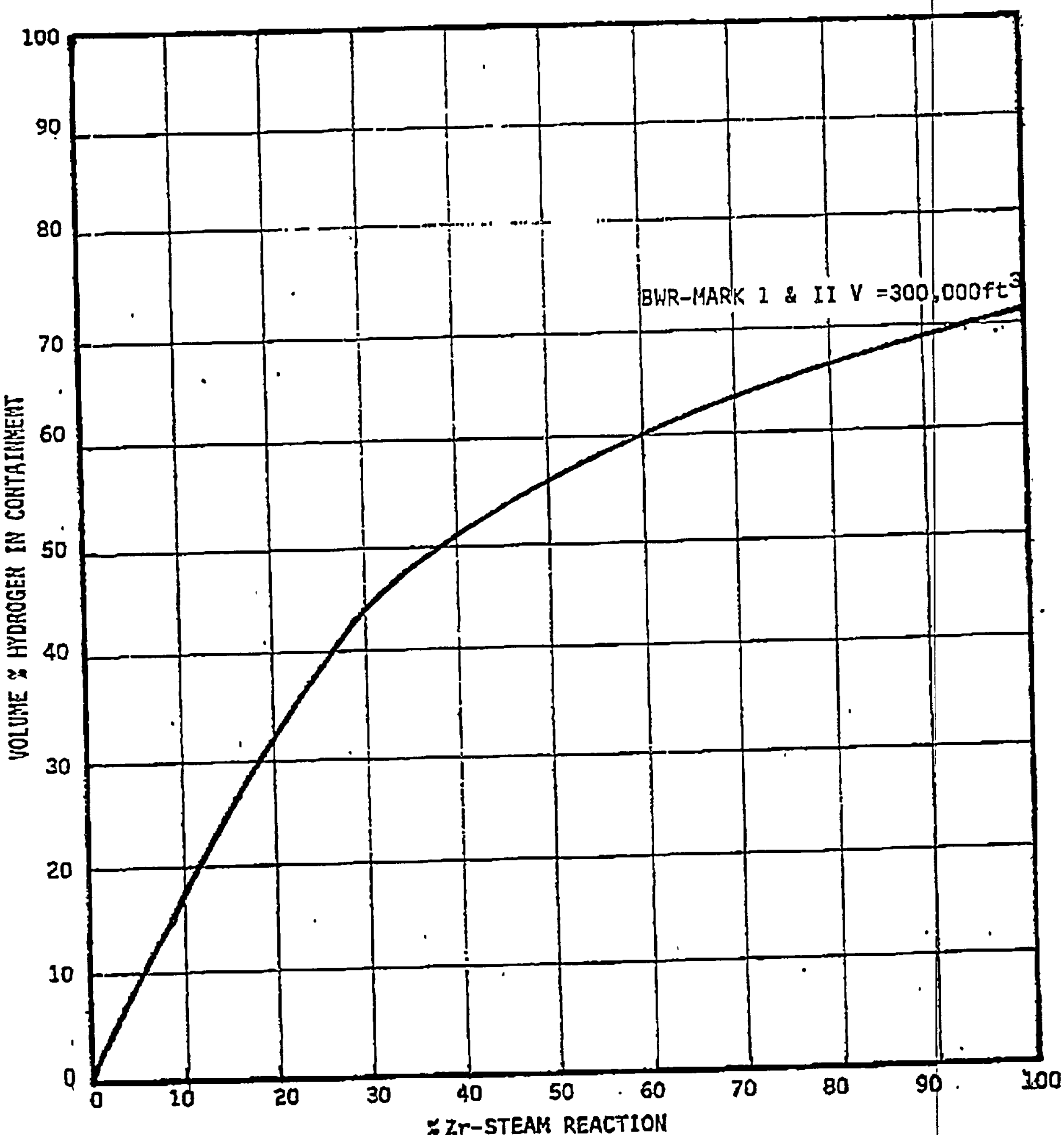
DOCUMENT TITLE: CORE DAMAGE ASSESSMENT	DOCUMENT NUMBER: 73EP-EIP-023-0S	Rev/Ver No: 0.3
ATTACHMENT 4 TITLE: % CONTAINMENT HYDROGEN VERSUS % ZR-STEAM REACTION		Att. Pg. 1 of 1



Containment % Hydrogen versus % Zr-Steam Reaction